

The Gentle Art of Questioning

WRITING GREAT CLICKER QUESTIONS

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*Credit should be given to: Stephanie Chasteen and the Science Education Initiative at the University of Colorado,
<http://colorado.edu/sei>*

Who are you?



★ Show of hands

- A. Natural sciences
- B. Social sciences
- C. Humanities
- D. Arts
- E. Languages
- F. Other

Have you used response systems (clickers) in your teaching?

- ★ Take a clicker & turn it on
- ★ If the green light flashes, your vote has been counted

- A. Not at all, and I haven't seen them used
- B. Not at all, but I've observed their use somewhat
- C. I've used them a little
- D. I've used them a lot
- E. I could be (should be?) *giving* this workshop

How familiar are you with Mazur’s “Peer Instruction”

 Colored cards

- A. Fairly familiar, and I like it
- B. Fairly familiar, but I’m not sure that I like it
- C. I’ve heard of it but only have a vague idea what it is
- D. Not familiar at all
- E. Not sure

Introducing Me

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Science Education Initiative

<http://colorado.edu/SEI>

Applying scientific principles to improve science education – What are students learning, and which instructional approaches improve learning?



Physics Education Research Group

<http://PER.colorado.edu>

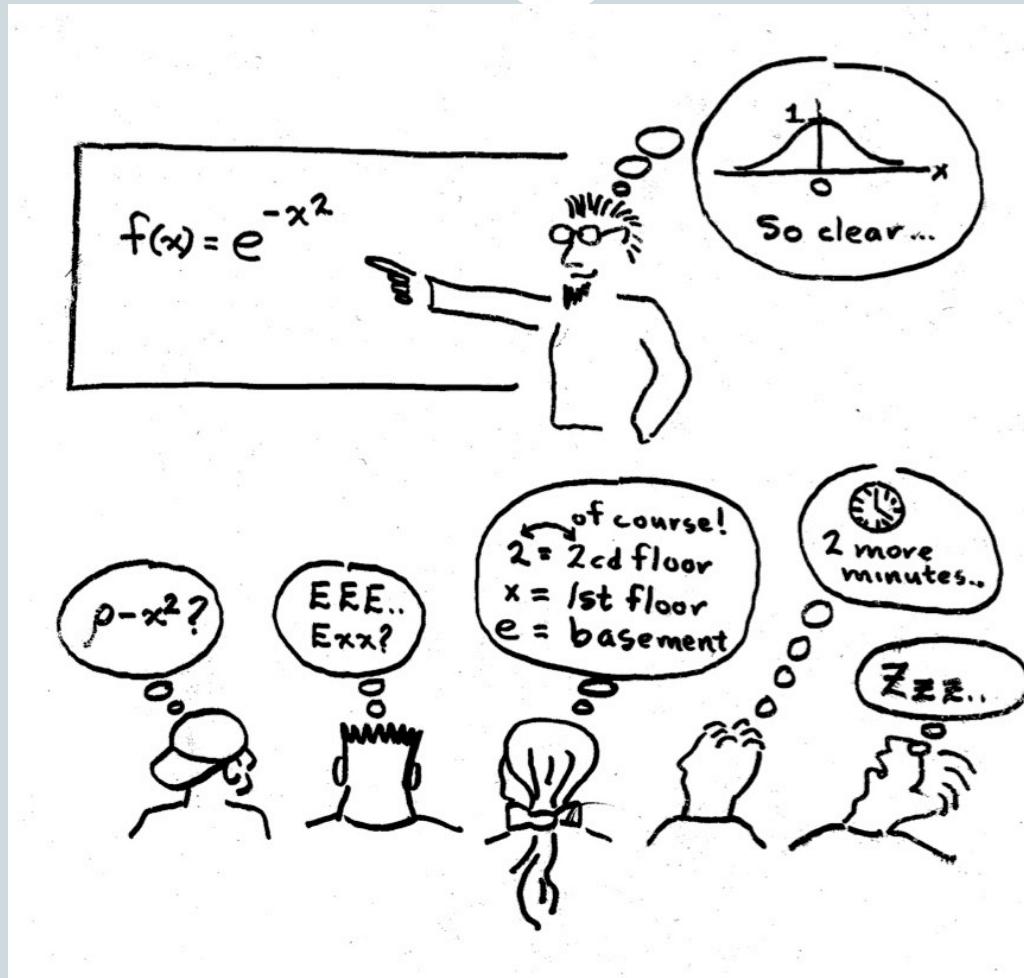
One of largest PER groups in nation, studying technology, attitudes, classroom practice, & institutional change.

Blogger

<http://blog.sciencegeekgirl.com>

Why question?

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Credit: Rosie Piller

whiteboard

Agenda

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- 1. When and how we can ask questions**
- 2. About clickers as a way to ask questions,**
- 3. Writing good questions.** Example questions, writing our own.
- 4. Action plan**

Learning goals: Participants will be able to....

- A. Explain several benefits of questioning and of using clickers to question
- B. Defend the use of best practices in questioning to overcome common challenges
- C. Formulate and revise clicker questions to target student learning goals

Exercise #1: Question goal brainstorm

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- What *goals* might clickers be used to achieve? Or, put another way, what might you use clicker questions to accomplish in your class?
- *Brainstorm in your handout, then we will discuss as a group.*

2 minutes



whiteboard

Some of my question goals

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BEFORE Setting up instruction

Motivate
Discover
Predict outcome
Provoke thinking
Assess prior knowledge



DURING Developing knowledge

Check knowledge
Application
Analysis
Evaluation
Synthesis
Exercise skill
Elicit misconception

AFTER Assessing learning

Relate to big picture
Demonstrate success
Review or recap
Exit poll

Credit: Rosie Piller and Ian Beatty.

Clickers are a tool for questioning

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Don't confuse the pedagogy with the technology!

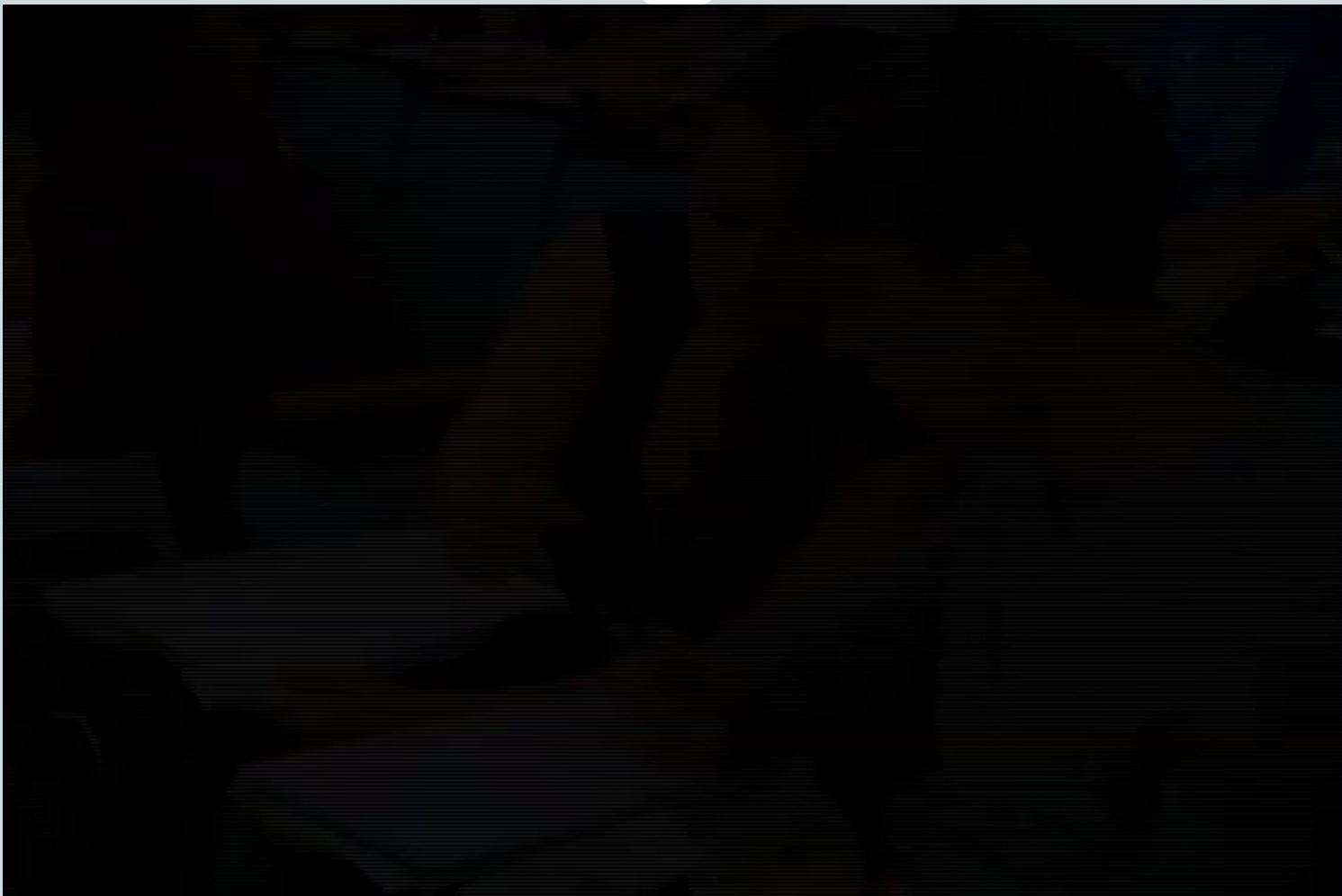


But not a magic bullet!

The perfect question doesn't solve all problems!

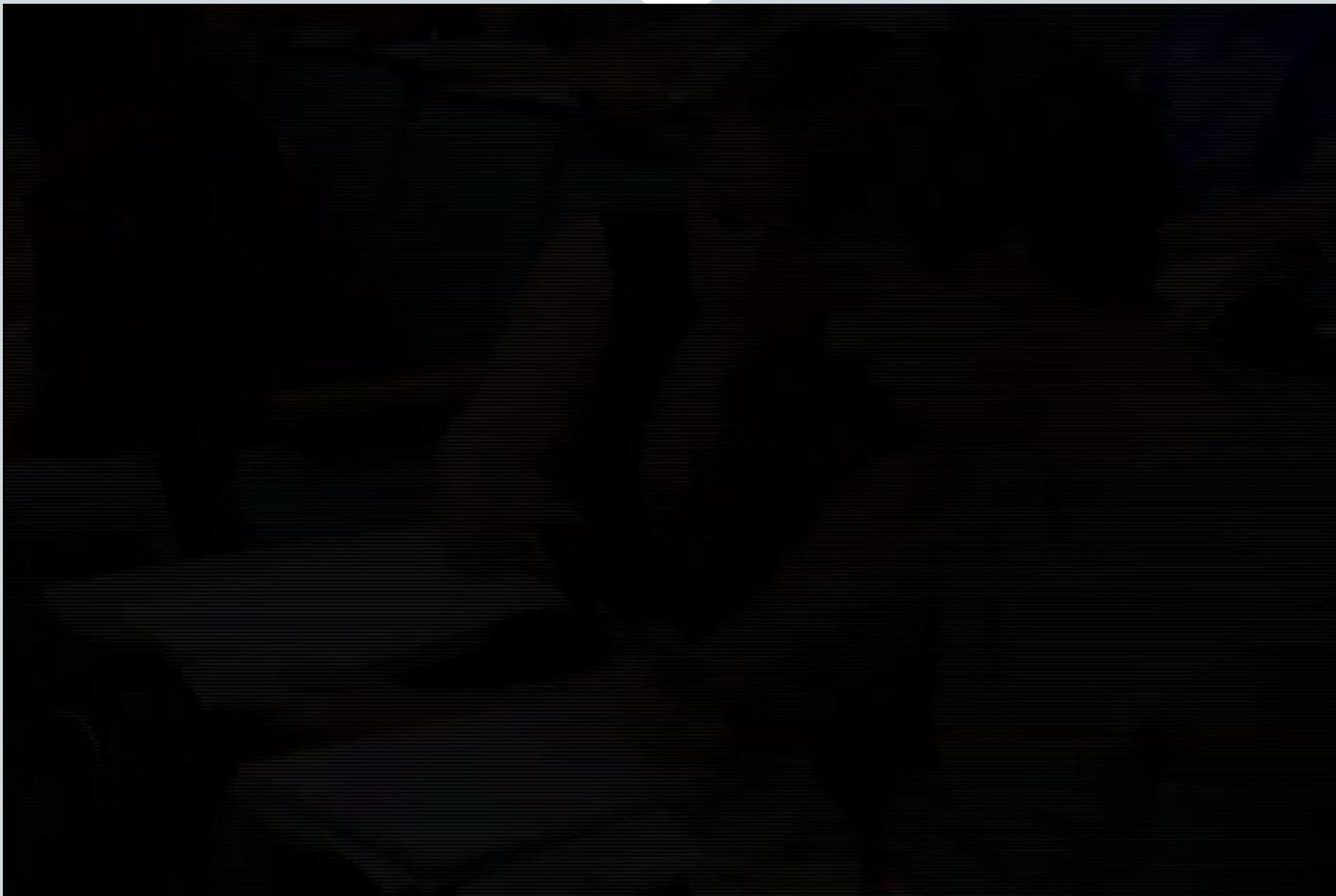
Why use clickers to target the class? An outline of Peer Instruction.

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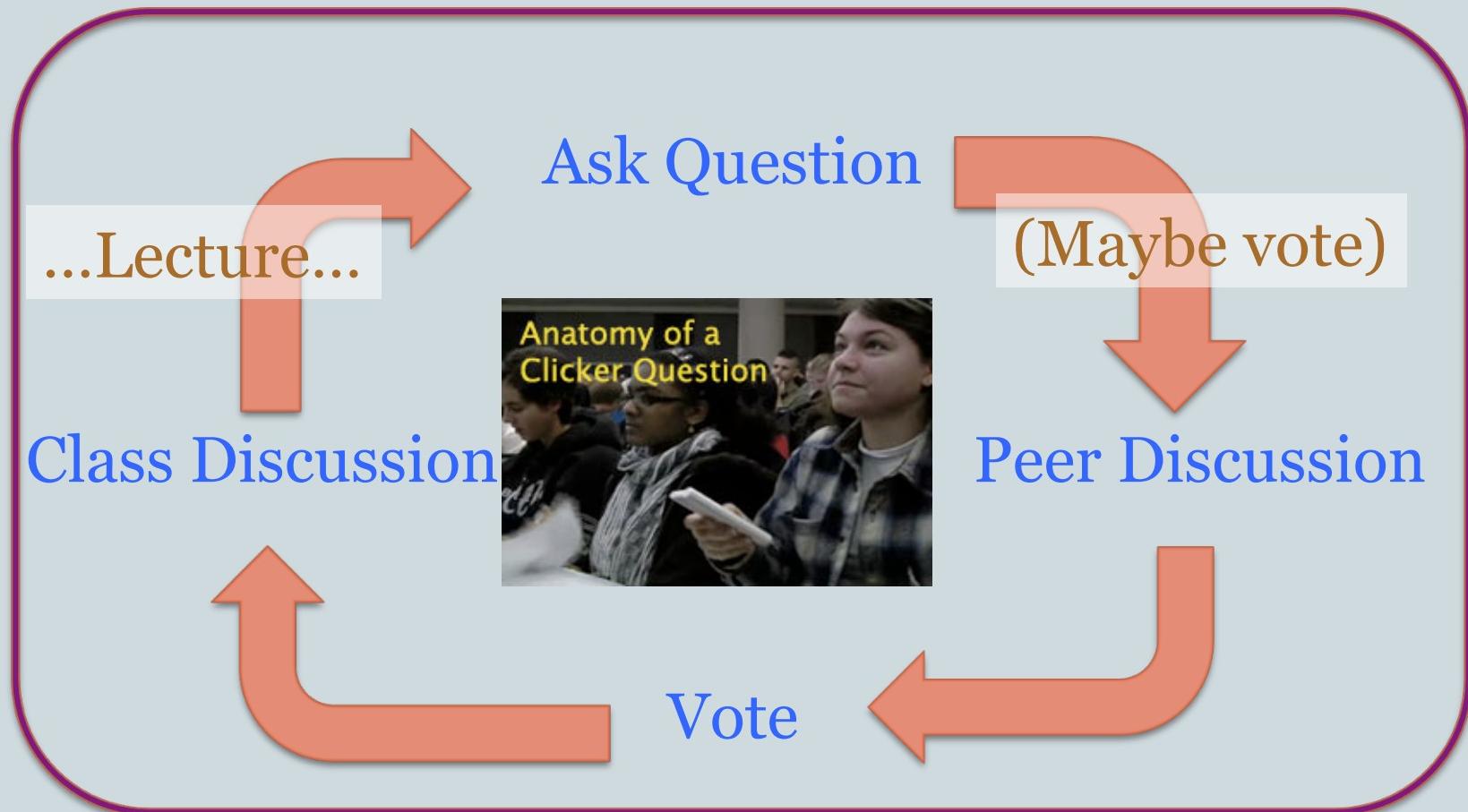
A quick outline of peer instruction

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Anatomy of Peer Instruction

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* See also: Peer Instruction, A User's Manual. E. Mazur.

What is special about clicker questions?

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- Similar in terms of goals
- Multiple choice
- Anonymous (to peers)
- Every student has a voice – the loud ones and the shy ones
- Forced wait time
- You can withhold the answer until everyone has had time to think (choose when to show the histogram)



What does this tool help us to do?

Which of these could be clicker questions?

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BEFORE Setting up instruction

Motivate
Discover
Predict outcome
Provoke thinking
Assess prior knowledge



DURING Developing knowledge

Check knowledge
Application
Analysis
Evaluation
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Exercise skill
Elicit misconception

AFTER Assessing learning

Relate to big picture
Demonstrate success
Review or recap
Exit poll

Credit: Rosie Piller and Ian Beatty.

Let's try it

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Which superpower would you rather have? The ability to...



- A. Change the mass of things
- B. Change the charge of things
- C. Change the magnetization of things
- D. Change the boiling point of things

What is the goal of this question?
When might you use it?

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Example question: Ethics



If you were a judge, how would you assess the “responsibility” of the U.S. Government, for what happened in the world between 1933 and 1945?

- A. Not responsible
- B. Minimally responsible
- C. Responsible
- D. Very responsible

What is the goal of this question?
When might you use it?

Example question: Math

Your sister in law calls to say that she's having twins. Which of the following is the most likely? (Assume she's having fraternal, not identical, twins)

- A. Twin boys
- B. Twin girls
- C. One girl and one boy
- D. All are equally likely



What is the goal of this question?
When might you use it?

Example question: Literature



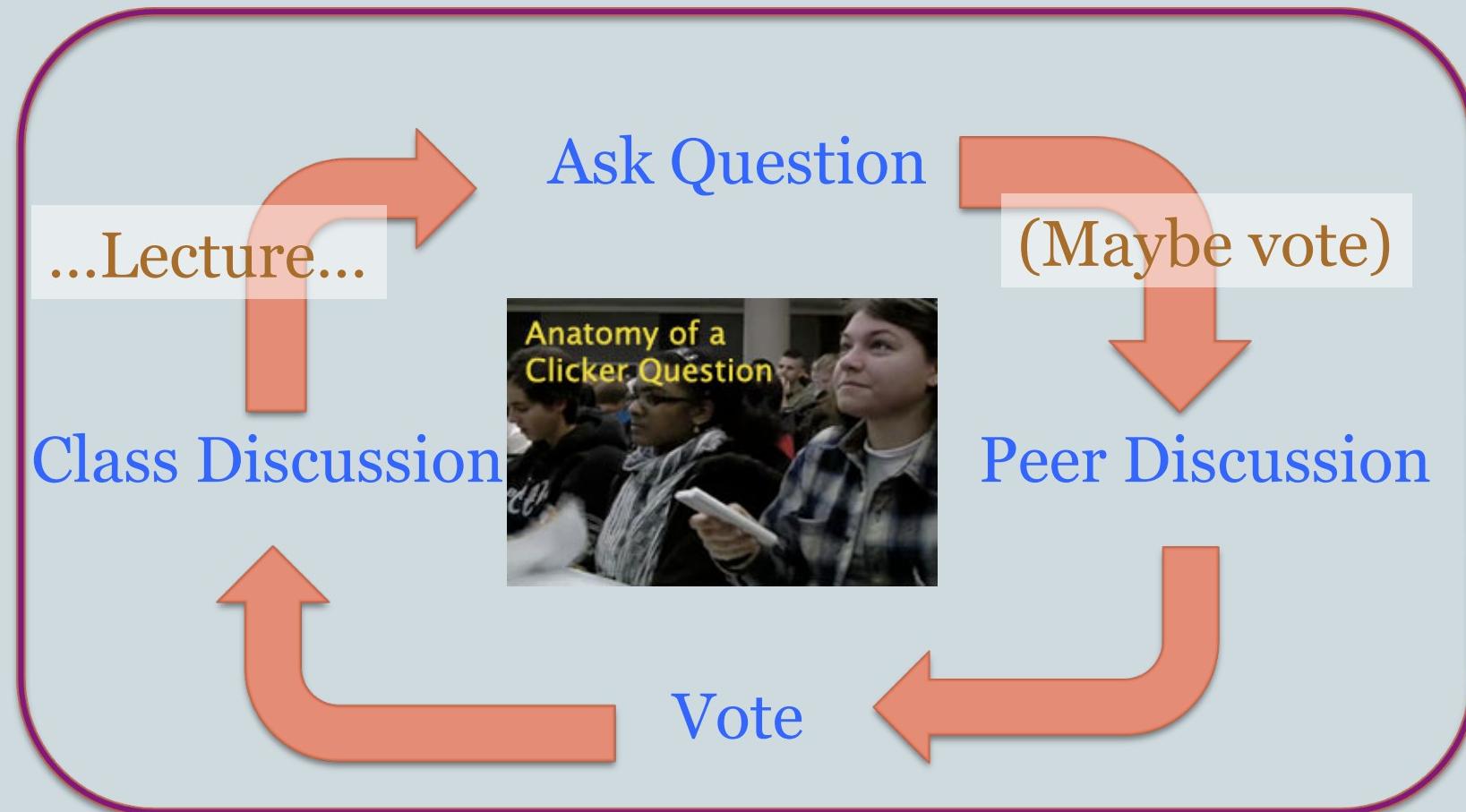
If Homer wrote the *Iliad* today, Stanley Fish and Harold Bloom would argue, respectively, whether the work should be categorized as:

- A. Existential vs. Romantic
- B. Postmodern vs Classical
- C. Modern vs Romantic
- D. Postcolonial vs Modern
- E. Preliterate vs Postliterate

What is the goal of this question?
When might you use it?

Questions?

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* See also: Peer Instruction, A User's Manual. E. Mazur.

Exercise #2: Try writing a question

- Choose one of the question goals (slide #3 on page 2 in handouts)
- Write a draft question that aims to achieve this goal.

3 minutes



Question-writing tips

- Move away from simple quizzes
- Use questions that prompt discussion
- Use questions that emphasize reasoning or process
- Use clear wording
- Use tempting distractors
- Use questions at a mixture of cognitive depth
- Ask challenging questions – don't just test memorized facts

See handout

Effective multiple-choice questions have *believable* “distracters.”

- 1) Talking with other instructors that have taught the course in the past.
- 2) Talking with your students one-on-one before class, after class, during office hours.
- 3) Using student responses to open-ended questions that you include in HW and exams.
- 4) Asking your students to come up with answers that will be used as the choices.
- 5) Use researched and documented student misconceptions.



An example question

What causes the seasons?

- A. The change in the earth's distance from the sun during the year
- B. The tilt of the earth's axis
- C. Changes in the sun's brightness
- D. Changes in clouds
- E. None of the above

Bad question.
Students can
answer by
memorizing a
word ("tilt")

Can we make a better question on the SAME topic?
Yes...

Better seasons example



What would happen to the seasons if the earth's orbit around the sun was made a perfect circle
(but nothing else changed) ?

- A. There would be no seasons
- B. The seasons would remain pretty much as they are today
- C. Winter to spring would differ much less than now
- D. Winter to spring would differ much more than now

Much better question. Requires reasoning!

Exercise #3: Revise your question

- Use what we've just talked about, and the "tips" in your handouts, to revise your question
- If you wish, swap with your neighbor and discuss.

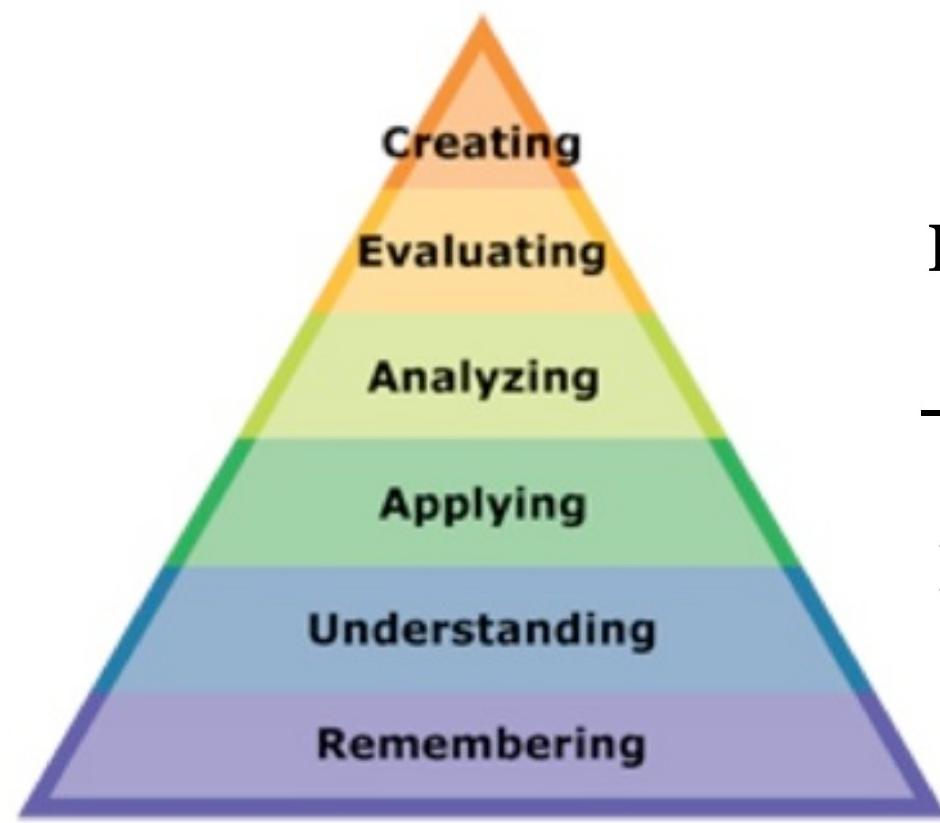
5 minutes



Use questions at a variety of cognitive depth

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Do the questions you use intellectually challenge your students or simply assess their factual knowledge?



Higher order

Lower order

handout

Exercise #4: Rate and swap

- Use the Bloom's Taxonomy worksheet to rate the Bloom's level of your question
- Swap your question with a neighbor. Do you agree on the Bloom's level of your question?
- Use the verbs on the detailed Bloom's handout to “Bloomify up” the level of your question.

5 minutes



What was the Bloom's level of your question?

- A. Remembering
- B. Understanding
- C. Applying
- D. Analyzing
- E. Evaluating

Share out

- 
- What did you learn in this process?
 - What worked well, what was challenging?
 - How might you go about writing questions in your class?

Gallery Walk

- Look at the “example questions” trios on the wall.
- What do these three questions have in common?
Jot any ideas down on the sheet.
- Might you use this type of question? When? For what purpose?

10 minutes



But...



The perfect question doesn't solve all problems!

I think the toughest thing about using clickers and peer instruction in class will be:

- 
- A. Writing good questions
 - B. Getting students to really think about them
 - C. Getting students to discuss the questions
 - D. Getting students to share their ideas in the class discussion
 - E. It takes too long / I have a lot of content to cover

Or something else? Write it on your handout!
What are some *solutions* to some of these challenges?

Some “best practices” and solutions



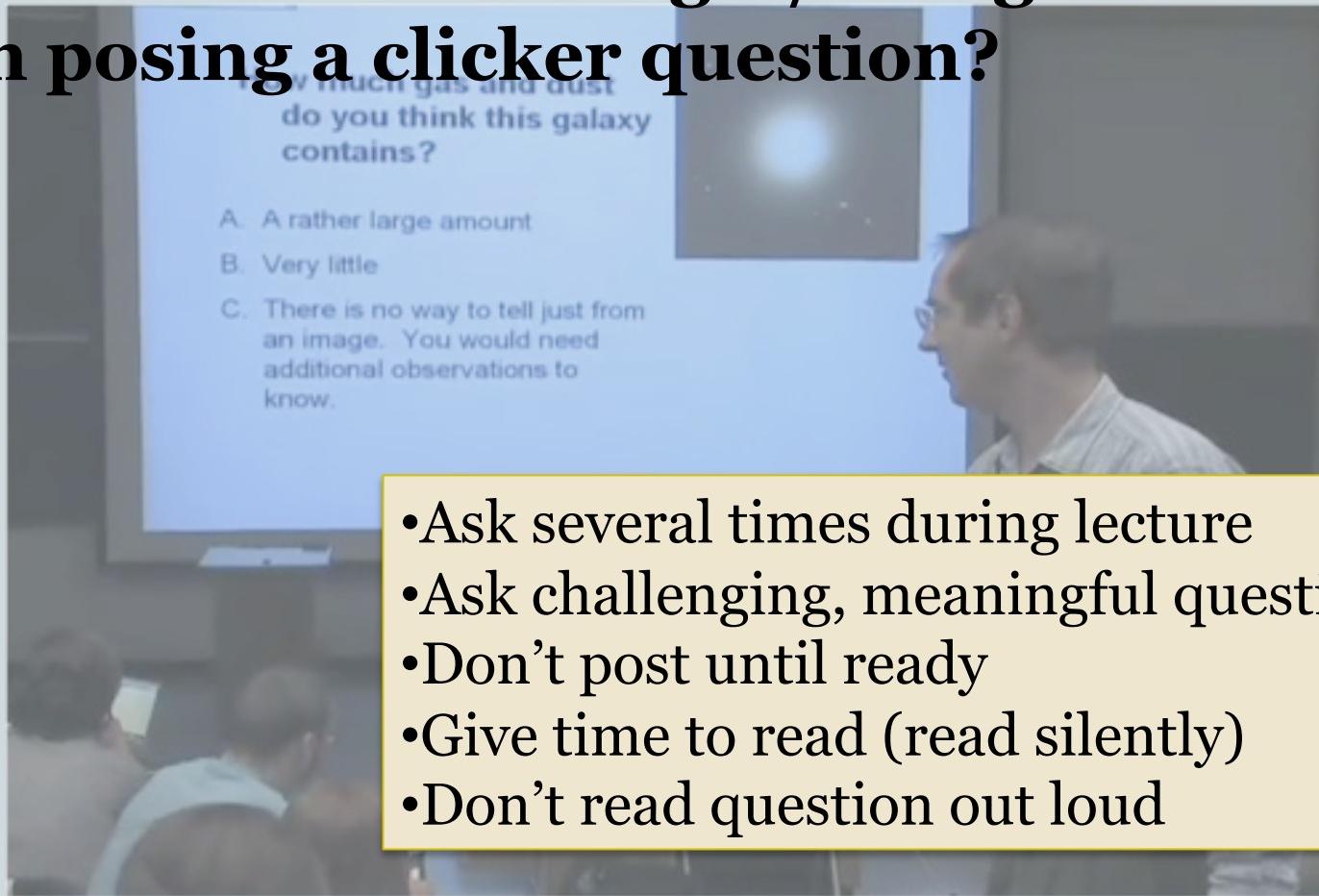
We'll do these quickly
These are repeated in handouts

- Underlying philosophy to most of these “best practices” are:
“It is important for students to discuss their ideas, to feel safe doing so, and for the teacher to be aware of those ideas”

1. Ask Question

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What are some challenges/ things to consider when posing a clicker question?



- A. A rather large amount
- B. Very little
- C. There is no way to tell just from an image. You would need additional observations to know.

- Ask several times during lecture
- Ask challenging, meaningful questions
- Don't post until ready
- Give time to read (read silently)
- Don't read question out loud

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Handout/worksheet / whiteboard

2. Peer Discussion

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Why is peer discussion important?

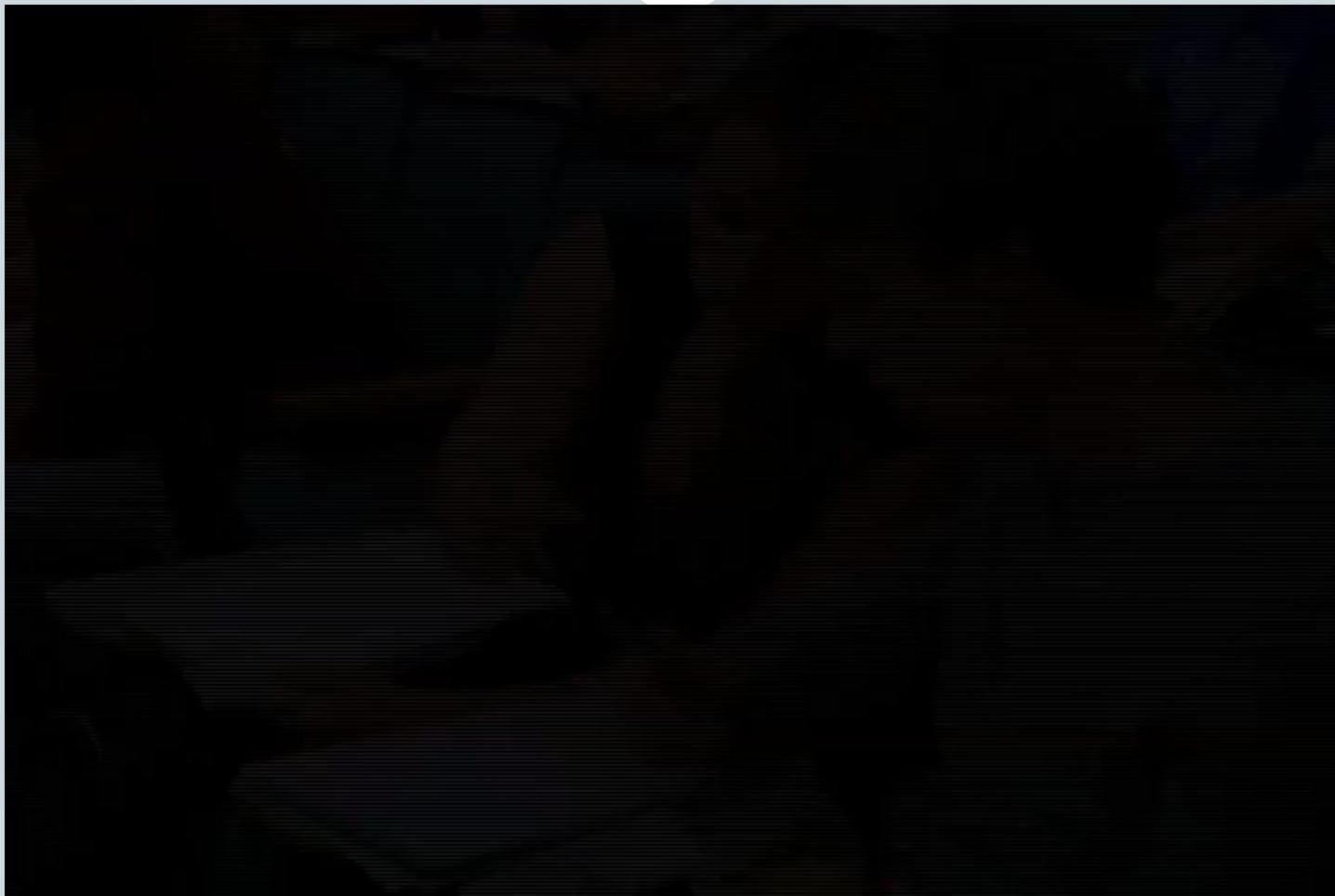
- Students learn more deeply by teaching each other
- Makes them articulate answer
- Lets you see inside their heads

What are challenges / how can you help make it work?



- Make it clear why you're doing this
- Circulate and ask questions / model
- Use questions they want to discuss
- Allow enough time (2-5 mins)
- Focus on reasoning in wrap-up

Student buy-in is key!

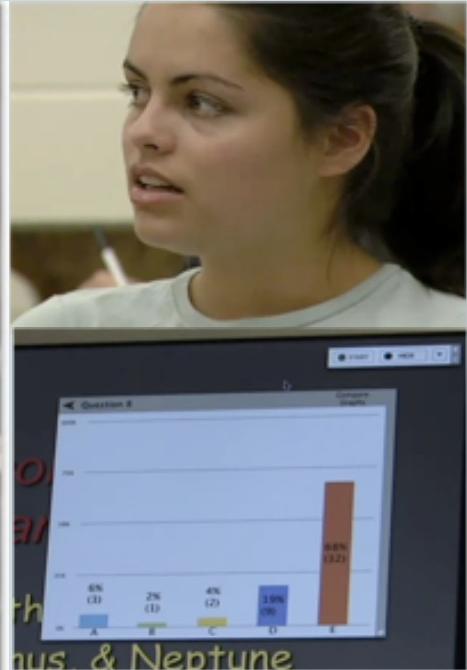


3. Wrap-Up Discussion

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**Challenges?
What might you
do to facilitate an
effective wrap-up
discussion?**

- Establish culture of respect
- Consider whether to show the histogram immediately
- Ask multiple students to defend their answers
- Why are wrong answers wrong and why right answer is right



Giving the answer stops student thinking!

Action Plan

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- Take a few minutes to write down your action plan to implement ideas you heard about in the workshop

U. Colorado clicker resources...

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Videos of effective use of clickers

2-5 mins long

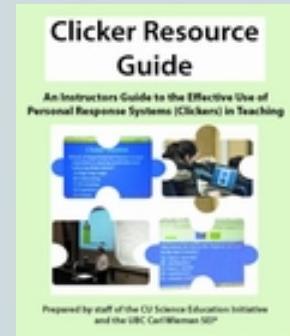
<http://STEMvideos.colorado.edu>



Clicker resource page

<http://STEMclickers.colorado.edu>

- Instructor's Guide
- Question banks
- Workshops
- Literature / Articles



References & Resources

Web and blog: <http://sciencegeekgirl.com>
Email: stephanie.chasteen@colorado.edu

Thanks!

- **Clicker Resource Page from the Science Education Initiative:** <http://STEMclickers.colorado.edu>. Has clicker question banks (in the sciences), an instructors' guide, and videos of classroom use. Useful books (such as Eric Mazur's *Peer Instruction*) are cited there.
- **Workshop handouts** will be uploaded to the above website, or email me.
- Many materials in this workshop (particularly the questioning cycle and the participant exercises) were adapted from **Rosie Piller**, Making Students Think: The Art of Questioning. Short papers published in: Computer Training & Support Conference, 1995; ISPI International Conferences, 1991 and 1996; ASTD National Conference on Technical & Skills Training, 1990. Related workshop description at <http://www.educationexperts.net/nstworkshop.html>
- Other materials (particularly sample clicker questions and goals of clicker questions) adapted from **Ian Beatty's** Technology Enhanced Formative Assessment (TEFA) program. <http://ianbeatty.com/crs>
- **My upcoming travel:** Chicago, West Virginia, Pittsburgh. Need a speaker?
- **Upcoming free webinar for K12.** See flyer.

Learning Goals



- **Biology:** Recognize the components of a cell and describe why each is necessary for the function of a cell
- **Physics:** Identify the different ways that light can interact with an object (i.e., transmitted, absorbed, reflected).
- **Chemistry:** Explain trends in boiling points in terms of intermolecular interactions
- **Earth science:** Understand the formation of the three major types of rocks (igneous, sedimentary, and metamorphic) and the processes by which they form, relating them by the rock cycle.
- **Math:** Solve a system of linear equations in two variables using algebra or graphing.

What Do I do if...?

45

What can you do if you ask questions and..

- There is no response
- The same people keep raising their hands
- The answers are called out before everyone has a chance to think
- The answers take too long
- Someone gives a wrong answer
- Only some students are prepared
- ?

*We'll discuss in
Workshop #2.*
For now: Many of
these challenges are
addressed by clickers